Part 1

Estimates, Units, and Percentages

`EUAP1.tex`

Exercise 1 *How many inches are in a mile?* $\boxed{63360}$ *inches* $= 1$ *mile*

`EUAP2.tex`

Exercise 2 *How many yards are in a mile?* $\boxed{1,760}$ *yards*$= 1$ *mile*

`EUAP3.tex`

Exercise 3 *How many tablespoons are in a gallon?* $\boxed{256}$ *tablespoons* $= 1$ *gallon*

`EUAP4.tex`

Exercise 4 *How many cups of gasoline could fit into a 15 gallon tank?* $\boxed{240}$ *cups* $= 15$ *gallons*

`EUAP5.tex`

Exercise 5 *How many centimeters are in a kilometer?* $\boxed{100000}$ $cm = 1$ km

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`EUAP6.tex`

Exercise 6 53 *dekaliters is how many milliliters?* $\boxed{530000}$ $mL = 53$ daL

`EUAP7.tex`

Exercise 7 *How many decigrams are in a hectogram?* $\boxed{1000}$ $dg = 1$ hg

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`EUAP8.tex`

Exercise 8 *How many millimeters are in a decimeter?* $\boxed{100}$ *mm* $= 1$ *dm*

`EUAP9.tex`

Exercise 9 *You go to a restaurant and end up with a bill for* \$13.78. *How much is a* 20% *tip? How much is an* 18% *tip?* 20% = \$$\boxed{2.76}$ 18% = \$$\boxed{2.48}$

`EUAP10.tex`

Exercise 10 *You have a coupon for* 30% *off and want to buy an item that is* \$48.98.

How much money will you save? \$$\boxed{14.69}$

How much money will you pay? \$$\boxed{34.29}$

`EUAP11.tex`

Exercise 11 *A paper company advertises on their box of 20 reams of printer paper that it is "99.99% jam free." How many sheets of paper would you expect to lose, assuming when a paper jam happens, you "lose" that jammed piece of paper? (A ream of paper is 500 sheets).* $\boxed{1}$ *sheet(s) will jam*

`EUAP12.tex`

Exercise 12 *Suppose 485 people arrived at and event before 10 am. By the end of the event, we know there had been 1,673 total event attendees. What percent of the attendees arrived before 10 am?* $\boxed{29}$%

`EUAP13.tex`

Exercise 13 *After a garage sale, you see that 35% of what was sold was old records. If 14 records were sold, how many total items were sold at the sale?* $\boxed{40}$

`EUAP14.tex`

Exercise 14 *A student is conducting a survey for his/her statistics class. He/She decides to poll 20% of the 1200 full-time students on campus and 40% of the 4000 part-time students. What percent of the total student population did the student survey?* $\boxed{35.4}\%$

`EUAP15.tex`

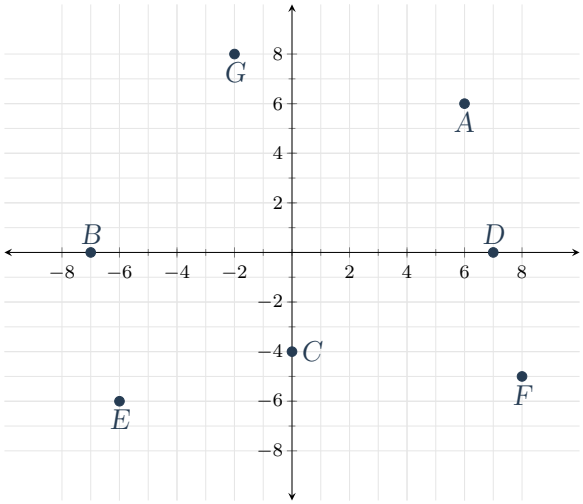
Exercise 15 *A shop owner raises the price of a* \$100 *pair of shoes by* 50%. *After a few weeks, because of falling sales, the owner reduces the price of the shoes by* 50%. *What is the new price of the shoes (after both percent changes have occurred)?* $\$\boxed{75}$

Part 2

Graphs and Relations

`RaG1.tex`

Exercise 16 *Give the Cartesian coordinates for each point on the graph:*



$$A = \left(\boxed{6}, \boxed{6}\right)$$
$$B = \left(\boxed{-7}, \boxed{0}\right)$$
$$C = \left(\boxed{0}, \boxed{-4}\right)$$
$$D = \left(\boxed{7}, \boxed{0}\right)$$
$$E = \left(\boxed{-6}, \boxed{-6}\right)$$
$$F = \left(\boxed{8}, \boxed{-5}\right)$$
$$G = \left(\boxed{2}, \boxed{8}\right)$$

`RaG2.tex`

Exercise 17 *For each given point, provide the quadrant in which it lies.*

(a) $(1, -2)$ *is in Quadrant* $\boxed{IV}$.

(b) $(72, 5)$ *is in Quadrant* $\boxed{I}$.

(c) $(-2.4, -2)$ *is in Quadrant* $\boxed{III}$.

(d) $(6, -0.8)$ *is in Quadrant* $\boxed{IV}$.

(e) $(-3, 2)$ *is in Quadrant* $\boxed{II}$.

(f) $(-\pi, \pi)$ *is in Quadrant* $\boxed{II}$.

`RaG3.tex`

Exercise 18 *Consider the relation with points of the form* (x, y)*, where* x *represents a distance given in miles, and* y *represents the same distance in feet. For example,* $(1, 5280)$ *is in the relation.*

Fill in the following table with the correct values of the relation:

Distance in Miles	*Distance in Feet*
0	$\boxed{0}$
$\boxed{1}$	5280
3	$\boxed{15840}$
6	$\boxed{31680}$
$\boxed{10}$	52800

`RaG4.tex`

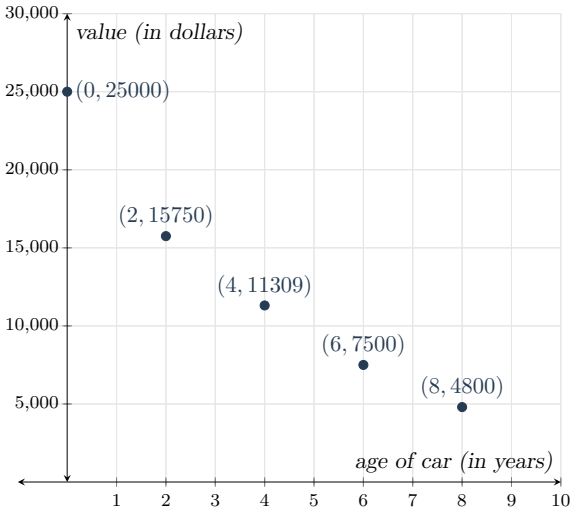
Exercise 19 *Consider the relation with points of the form* (x, y)*, where* x *represents a volume given in liters, and* y *represents the same volume in milliliters. For example,* $(1, 1000)$ *is in the relation.*

Fill in the following table with the correct values of the relation:

Volume in Liters	*Volume in Milliliters*
0	$\boxed{0}$
$\boxed{1}$	1000
3	$\boxed{3000}$
16	$\boxed{16000}$
$\boxed{528}$	528000

`RaG5.tex`

Exercise 20 *Look at the following graph:*



Fill in the table below to give another representation of the relation given in the graph.

Age of Car	*Value*
0	25000
2	15750
4	11309
6	7500
8	4800

`RaG6.tex`

Exercise 21 *For each given point, say whether it is a member of the relation given by* $x^2 - y^2 = 1$.

(a) *Is* $(1, -2)$ *in the relation?*

Multiple Choice:

(i) *Yes*
(ii) *No* ✓

(b) *Is* $(1, 0)$ *in the relation?*

Multiple Choice:

(i) *Yes* ✓
(ii) *No*

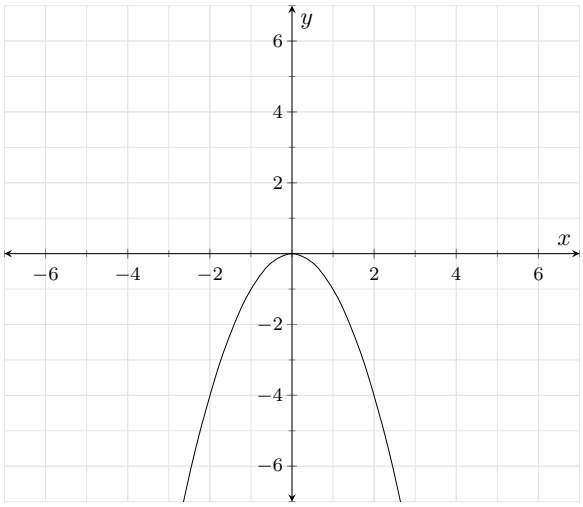
(c) *Is* $(0, -1)$ *in the relation?*

Multiple Choice:

(i) *Yes*
(ii) *No* ✓

`RaG7.tex`

Exercise 22 *Look at the following graph:*



Which type of famous function from the chapter is represented above?

Multiple Choice:

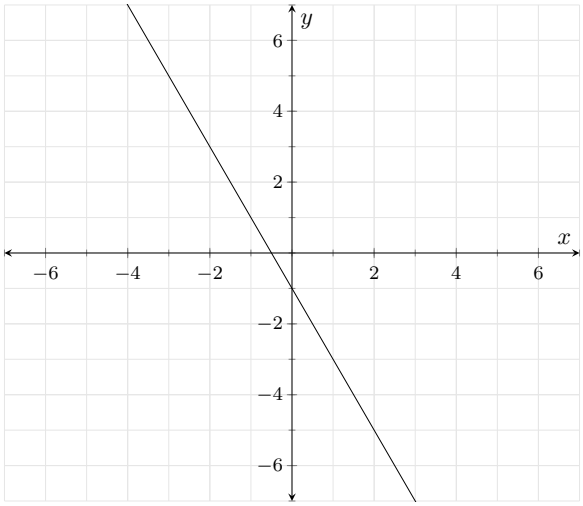
(a) *Parabola* ✓

(b) *Exponential*

(c) *Linear*

`RaG8.tex`

Exercise 23 *Look at the following graph:*



Which type of famous function from the chapter is represented above?

Multiple Choice:

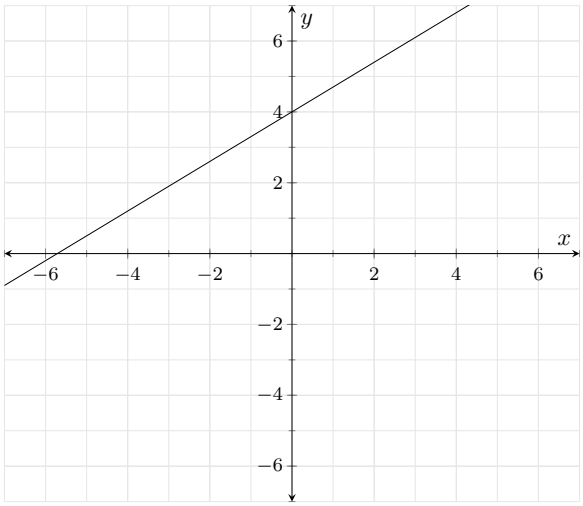
(a) *Parabola*

(b) *Exponential*

(c) *Linear* ✓

`RaG9.tex`

Exercise 24 *Look at the following graph:*



Which type of famous function from the chapter is represented above?

Multiple Choice:

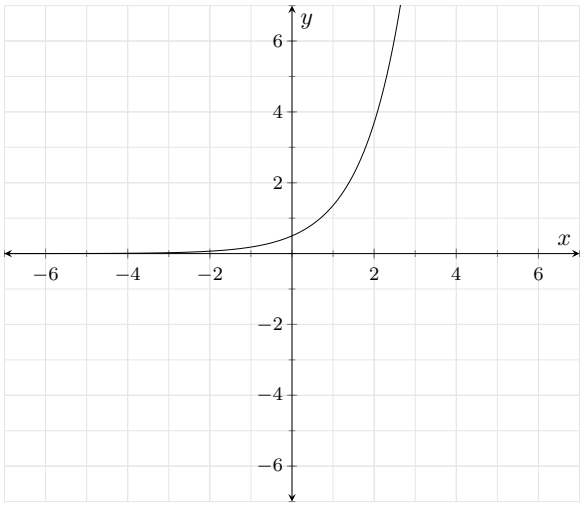
(a) *Parabola*

(b) *Exponential*

(c) *Linear* ✓

`RaG10.tex`

Exercise 25 *Look at the following graph:*



Which type of famous function from the chapter is represented above?

Multiple Choice:

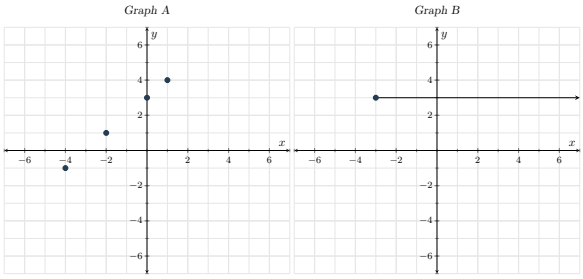
(a) *Parabola*

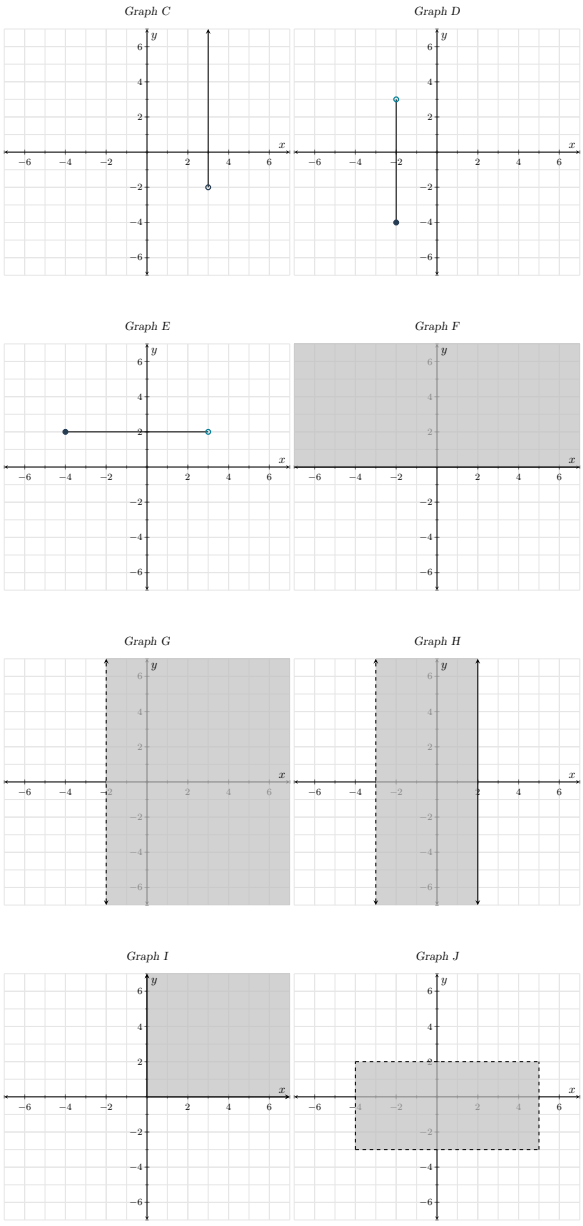
(b) *Exponential* ✓

(c) *Linear*

`RaG11.tex`

Exercise 26 *Look at the following graphs and match each to a description of a relation below:*





(a) *The points* (x, y) *with* $-3 < x \leq 2$.

Multiple Choice:

(i) A

(ii) B

(iii) C
(iv) D
(v) E
(vi) F
(vii) G
(viii) H ✓
(ix) I
(x) J

(b) *The points* (x, y) *with* $x = -2$ *and* $-4 \leq y < 3$.

Multiple Choice:

(i) A
(ii) B
(iii) C
(iv) D ✓
(v) E
(vi) F
(vii) G
(viii) H
(ix) I
(x) J

(c) *The points* (x, y) *with* $x > -2$.

Multiple Choice:

(i) A
(ii) B
(iii) C
(iv) D
(v) E
(vi) F
(vii) G ✓
(viii) H
(ix) I
(x) J

(d) *The points* (x, y) *with* $x \geq 0$ *and* $y \geq 0$.

Multiple Choice:

(i) A
(ii) B
(iii) C
(iv) D
(v) E
(vi) F
(vii) G
(viii) H
(ix) I ✓
(x) J

(e) *The points* (x, y) *with* $-4 < x < 5$ *and* $-3 < y < 2$.

Multiple Choice:

(i) A
(ii) B
(iii) C
(iv) D
(v) E
(vi) F
(vii) G
(viii) H
(ix) I
(x) J ✓

(f) *The points* (x, y) *with* $-4 \leq x < 3$ *and* $y = 2$.

Multiple Choice:

(i) A
(ii) B
(iii) C
(iv) D
(v) E ✓

(vi) F
(vii) G
(viii) H
(ix) I
(x) J

(g) *The points* (x, y) *with* $-3 \leq x$ *and* $y = 3$.

Multiple Choice:

(i) A
(ii) B ✓
(iii) C
(iv) D
(v) E
(vi) F
(vii) G
(viii) H
(ix) I
(x) J

(h) *The points* (x, y) *with* $y \geq 0$.

Multiple Choice:

(i) A
(ii) B
(iii) C
(iv) D
(v) E
(vi) F ✓
(vii) G
(viii) H
(ix) I
(x) J

(i) *The points* $(-4, -1)$, $(-2, 1)$, $(0, 3)$, *and* $(1, 4)$.

Multiple Choice:

(i) A ✓
(ii) B
(iii) C
(iv) D
(v) E
(vi) F
(vii) G
(viii) H
(ix) I
(x) J

(j) *The points* (x, y) *with* $x = 3$ *and* $y > -2$.

Multiple Choice:

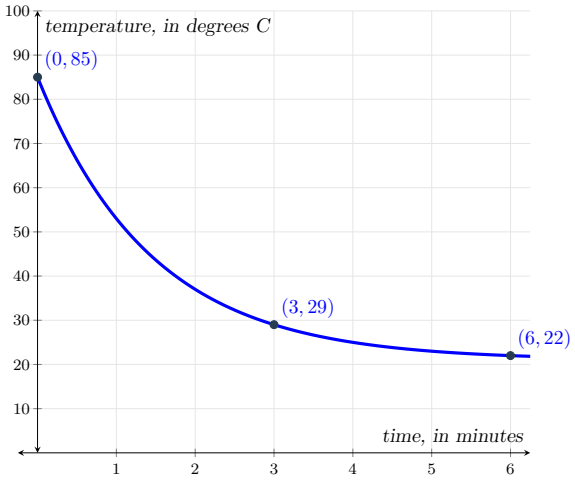
(i) A
(ii) B
(iii) C ✓
(iv) D
(v) E
(vi) F
(vii) G
(viii) H
(ix) I
(x) J

Part 3

Linear Equations

`LE1.tex`

Exercise 27 *The graph below shows the temperature T, in degrees Celsius, of an object at time t, in minutes.*



(a) *Based on the graph above, is this object heating up or cooling down?*

Multiple Choice:

(i) *Heating Up*

(ii) *Cooling Down* ✓

(b) *What is the rate of change in this data between the point corresponding to $t = 0$ minutes, and the point corresponding to $t = 3$ minutes?* $\boxed{-56/3}$ *degrees Celsius/minute.*

Hint: *Recall that the rate of change between two data points is given by* $\dfrac{\Delta T}{\Delta t}$.

(c) *What is the rate of change in this data between the point corresponding to $t = 3$ minutes, and the point corresponding to $t = 6$ minutes?* $\boxed{-7/3}$ *degrees Celsius/minute.*

(d) *Based on the your answers above, does this data always have the same rate of change?*

Multiple Choice:

(i) *Yes*

(ii) *No* ✓

`LE2.tex`

Exercise 28 *A table of data is given below.*

x	y
0	2
1	5
2	8
5	

(a) *The rate of change from the top row to the second row is:* $\boxed{3}$.

(b) *The rate of change from the top row to the second row is:* $\boxed{3}$.

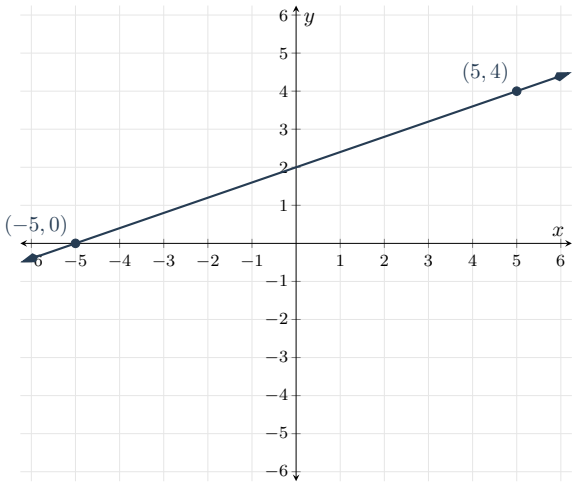
(c) *If this rate of change is maintained, whenever the x-value of a data point increases by 1, the y-value of the data point must increase by* $\boxed{3}$.

(d) *If this rate of change is maintained, whenever the x-value of a data point increases by 3, the y-value of the data point must increase by* $\boxed{9}$.

(e) *If this rate of change is maintained, the x-value 5 corresponds to the y-value* $\boxed{17}$.

(f) *An equation that describes the pattern in the table is* $y = \boxed{3x + 2}$.

`LE3.tex`



Exercise 29

(a) *The slope of this line is*

Multiple Choice:

(i) *positive because y is increasing* ✓
(ii) *positive because y is decreasing*
(iii) *negative because y is increasing*
(iv) *negative because y is decreasing*

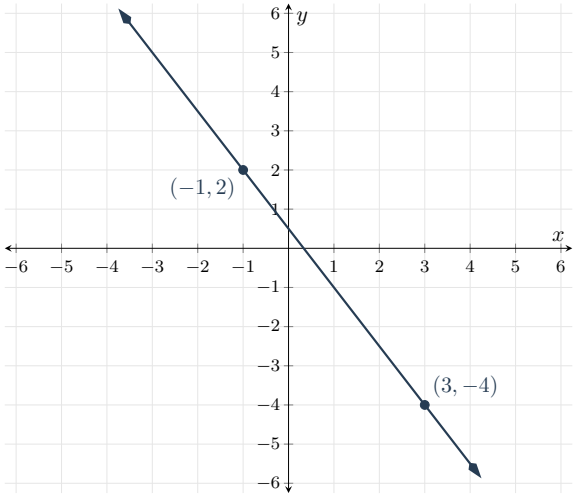
(b) *The slope of this line is* $m = \boxed{2/5}$.

Hint: *Recall that the slope of the line is the rate of change between any two data points on the line,* $m = \dfrac{\Delta y}{\Delta x}$.

(c) *The y-value of the point corresponding to $x = 9$ is* $\boxed{28/5}$.

Hint: *How much y increases if x increases by 1? How much does y increase if x increases by 4?*

`LE4.tex`



Exercise 30

(a) *The slope of this line is*

Multiple Choice:

(i) *positive because y is increasing*
(ii) *positive because y is decreasing*
(iii) *negative because y is increasing*
(iv) *negative because y is decreasing* ✓

(b) *The slope of this line is* $m = \boxed{-3/2}$.

Hint: *Recall that the slope of the line is the rate of change between any two data points on the line,* $m = \dfrac{\Delta y}{\Delta x}$.

(c) *The y-value of the point corresponding to $x = 0$ is* $b = \boxed{1/2}$.

(d) *The point-intercept form of the equation of this line is* $y = \boxed{-3/2}\,x + \boxed{1/2}$.

(e) *The point-slope form of the equation of this line is* $y - 2 = \boxed{-3/2}\left(x - \boxed{-1}\right)$.

(f) *The equation of this line in standard form* $\boxed{3}\,x + \boxed{2}\,y = 1$.

`LE5.tex`

Exercise 31 *A particular car is known to have a fuel efficiency of 32 miles/-gallon (mpg).*

(a) *If this car is driven 32 miles, it uses* $\boxed{1}$ *gallons of fuel.*

(b) *If this car is driven 96 miles, it uses* $\boxed{3}$ *gallons of fuel.*

(c) *Call x the number of miles driven and y the gallons of fuel used. Then x and y have a linear relationship.*

(i) *The slope of this linear relationship is* $\boxed{1/32}$ *gallons/mile.*

(ii) *The equation of this line in slope-intercept form is given by* $y = \boxed{(1/32) * x + 0}$.

`LE6.tex`

Exercise 32 *Vertical Lines*

Vertical lines do not have a slope. They consist of all points with the same x-coordinate. For example, the linear relationship with data given in this table consists of points with x-coordinate equal to 5.

x	y
5	-1
5	0
5	1
5	2

Since this line does not have a slope, we can not express its equation in either point-slope or slope-intercept forms. Instead, a vertical line has an equation of the form $x = C$, where C is the common x-coordinate between all the points, meaning that the line given in the table above has equation $x = 5$.

(a) *The line given by the following table of data:*

x	y
2	-3
2	1
2	1
2	3
2	5

has equation given by $x = \boxed{2}$.

(b) *The line given by the following table of data:*

x	y
$-3/4$	-8
$-3/4$	-7
$-3/4$	-6
$-3/4$	-5

has equation given by $x = \boxed{-\frac{3}{4}}$.

LE7.tex

Exercise 33 *Parallel lines*

> *Remember that two lines in the plane are parallel if they never intersect. This means that they are each traveling in the same direction. Any two vertical lines are parallel. Any two horizontal lines are parallel. Two non-vertical lines are parallel if and only if they have the same slope.*

(a) *Suppose a line has equation* $y = 3x + 4$. *An equation of the line parallel to this line, with y-intercept at* $(0, -2)$ *is given in slope-intercept form by* $y = \boxed{3}x + \boxed{-2}$.

(b) *Suppose a line has equation* $x = -2$. *An equation of the line parallel to this, which passes through the point* $(4, 2)$ *has equation* $x = \boxed{4}$.

(c) *Suppose a line has equation* $5x + 2y = -4$. *An equation of the line parallel to this, which passes through the point* $(2, -3)$ *is given in point-slope form by* $y - \boxed{-3} = \boxed{-5/2}\left(x - \boxed{2}\right)$.

LE8.tex

Exercise 34 *Perpendicular lines*

Remember that two lines in the plane are perpendicular if the intersect at a right-angle, of 90°. Any vertical line is perpendicular to any horizontal line. Two non-vertical lines are perpendicular if and only if their slopes multiply to -1. That is, if the slope of the first line m_1 and the slope of the second line m_2 have $m_1 m_2 = -1$.

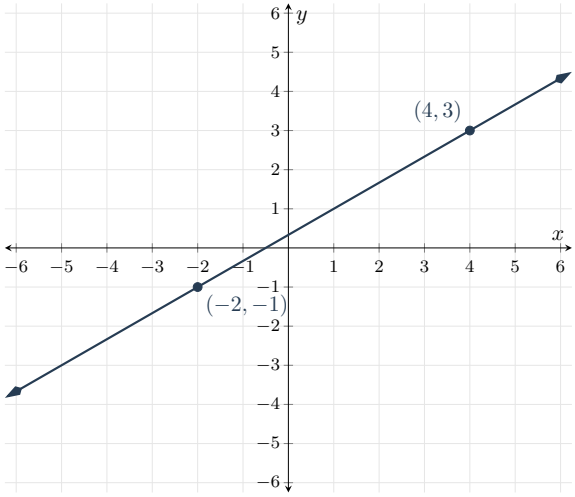
(a) *Suppose a line has equation $y = 3x + 4$. An equation of the line perpendicular to this line, with y-intercept at $(0, -2)$ is given in slope-intercept form by* $y = \boxed{-1/3}x + \boxed{-2}$.

(b) *Suppose a line has equation $x = -2$. An equation of the line perpendicular to this, which passes through the point $(4, 2)$ has equation* $y = \boxed{2}$.

(c) *Suppose a line has equation $5x + 2y = -4$. An equation of the line perpendicular to this, which passes through the point $(2, -3)$ is given in point-slope form by* $y - \boxed{-3} = \boxed{2/5}\left(x - \boxed{2}\right)$.

`LE9.tex`

Exercise 35 *The graph of a line is given below.*



(a) *The line parallel to this graphed line, which passes through the point $(3, 1)$ has equation in point-slope form given by* $y - \boxed{1} = \boxed{2/3}\left(x - \boxed{3}\right)$.

(b) *The line perpendicular to this graphed line, which passes through the point $(-2, 3)$ has equation in slope-intercept form given by* $y = \boxed{-3/2}x + \boxed{0}$.

Part 4

Linear Modeling

`LM1.tex`

Exercise 36 *A landscaping company charges \$45 per cubic yard of mulch plus a delivery charge of \$20.*

(a) *A linear function which computes the total cost C (in dollars) to deliver x cubic yards of mulch is given by* $y = \boxed{45x + 20}$.

(b) *According to the linear function above, 20 cubic yards of mulch costs* $\boxed{920}$.

(c) *According to the linear function above, \$560 will buy you* $\boxed{12}$ *cubic yards of mulch.*

`LM2.tex`

Exercise 37 *Water freezes at 0° Celsius and 32° Fahrenheit and it boils at $100^\circ C$ and $212^\circ F$.*

Write your answers as improper fractions if necessary.

(a) *A linear function F that expresses temperature in the Fahrenheit scale in terms of degrees Celsius (which we represent by the variable x) is* $F(x) = \boxed{(9/5)x + 32}$.

(b) *Using the above function, $20^\circ C$ is* $\boxed{68}^\circ$ *Fahrenheit.*

(c) *A linear function C that expresses temperature in the Celsius scale in terms of degrees Fahrenheit (which we represent by the variable x) is* $C(x) = \boxed{(5/9)x - 160/9}$.

(d) *Using the above function, $110^\circ F$ is* $\boxed{130/3}^\circ$ *Celsius.*

(e) *The temperature x at which $F(x) = C(x)$ is* $\boxed{-40}^\circ$.

`LM3.tex`

Exercise 38 *Your friend buys a new car, and as soon as they drive it off the lot, it begins to depreciate in value. After 2 years, the car is worth \$16,000 and after 4 years, the car is worth \$12,000. Assume that the car's value drops linearly.*

(a) *A linear function V that expresses the value of the car in terms of the number of years x since it was purchased is* $V(x) = \boxed{-2000x + 20000}$.

(b) *The y-intercept of the function V is* $(\boxed{0}, \boxed{20000})$.

(c) *The y value of the y-intercept represents*

Multiple Choice:

(i) *the starting value of the car.* ✓

(ii) *the time at which the car's value is 0.*

(iii) *the average value of the car over its lifespan.*

(d) *The x-intercept of the function V is* $(\boxed{40}, \boxed{0})$.

(e) *The x value of the x-intercept represents*

Multiple Choice:

(i) *the starting value of the car.*

(ii) *the time at which the car's value is 0.* ✓

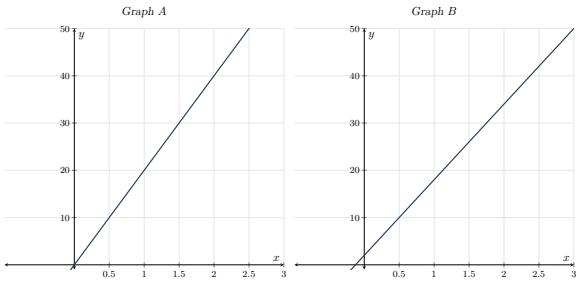
(iii) *the average value of the car over its lifespan.*

`LM4.tex`

Exercise 39 *You and your friend decide to have a bike race. Your speed is 16 kilometers per hour, and your friend's is 20 kilometers per hour. Your friend is faster than you are, so they give you a head start of 2 kilometers.*

Let $f(x)$ be a linear function expressing the distance (in kilometers) you travel, and $g(x)$ be a linear function expressing the distance (in kilometers) your friend travels.

(a) *One of the following graphs represents $f(x)$ and the other represents $g(x)$.*



The graph representing $f(x)$ is

Multiple Choice:

(i) *Graph A.*
(ii) *Graph B.* ✓

(b) *A linear equation for the distance you travel is* $f(x) = \boxed{16x + 2}$.

(c) *A linear equation for the distance your friend travels is* $g(x) = \boxed{20x}$.

(d) *If the race is 5 kilometers long, who will win?*

Multiple Choice:

(i) *You* ✓
(ii) *Your friend*
(iii) *It will be a tie*

(e) *If the race is 10 kilometers long, who will win?*

Multiple Choice:

(i) *You*
(ii) *Your friend*
(iii) *It will be a tie* ✓

(f) *If the race is 20 kilometers long, who will win?*

Multiple Choice:

(i) *You*
(ii) *Your friend* ✓
(iii) *It will be a tie*

`LM5.tex`

Exercise 40 *A salesperson is paid \$200 per week plus 5% commission on her weekly sales of x dollars.*

(a) *A linear function that represents her total weekly pay, W (in dollars) in terms of x is* $W(x) = \boxed{.05x + 200}$.

(b) *In order for her to earn \$475 for the week, her weekly sales must be* \$ $\boxed{5500}$.

Part 5

Function Properties

`FP1.tex`

Exercise 41 *Let f be a function defined as follows.*

$$f(x) = \begin{cases} x^2, & x < 0 \\ x, & x \geq 0 \end{cases}$$

(a) *Compute $f(1)$.*
$f(1) = \boxed{1}$

(b) *Compute $f(-1)$.*
$f(-1) = \boxed{1}$

(c) *The calculations in parts (a) and (b) above show that f is*

Multiple Choice:

(i) *neither even nor odd.*
(ii) *even but not odd.*
(iii) *odd but not even.*
(iv) *both even and odd.*
(v) *not odd, but f may not be even.* ✓
(vi) *not even, but f may not be odd.*

(d) *Compute $f(2)$.*
$f(2) = \boxed{2}$

(e) *Compute $f(-2)$.*
$f(-2) = \boxed{4}$

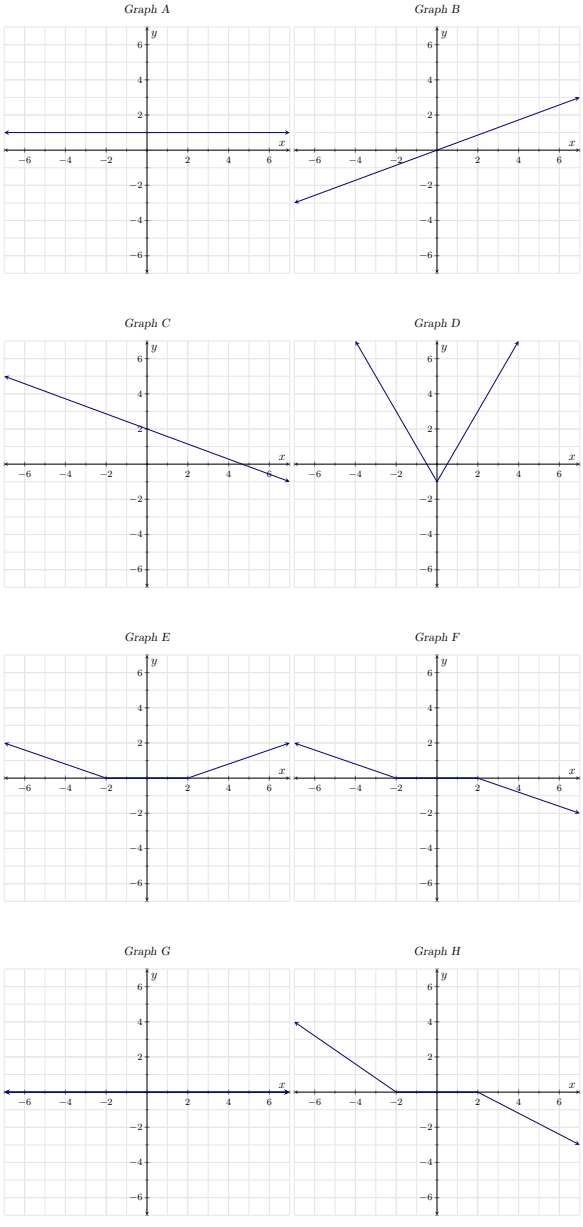
(f) *The calculations in parts (d) and (e) above show that f is*

Multiple Choice:

(i) *neither even nor odd.* ✓
(ii) *even, but not odd.*
(iii) *odd, but not even.*
(iv) *both even and odd.*
(v) *The calculations do not say anything about whether f is even or odd.*

`FP2.tex`

Exercise 42 *Look at the following graphs of functions. Assume that all the important behavior of the functions is shown on the graphs below.*



(a) *The function corresponding to Graph A is*

Multiple Choice:

(i) *neither even nor odd.*
(ii) *even, but not odd.* ✓
(iii) *odd, but not even.*
(iv) *both even and odd.*

(b) *The function corresponding to Graph B is*

Multiple Choice:

(i) *neither even nor odd.*
(ii) *even, but not odd.*
(iii) *odd, but not even.* ✓
(iv) *both even and odd.*

(c) *The function corresponding to Graph C is*

Multiple Choice:

(i) *neither even nor odd.* ✓
(ii) *even, but not odd.*
(iii) *odd, but not even.*
(iv) *both even and odd.*

(d) *The function corresponding to Graph D is*

Multiple Choice:

(i) *neither even nor odd.*
(ii) *even, but not odd.* ✓
(iii) *odd, but not even.*
(iv) *both even and odd.*

(e) *The function corresponding to Graph E is*

Multiple Choice:

(i) *neither even nor odd.*
(ii) *even, but not odd.* ✓
(iii) *odd, but not even.*
(iv) *both even and odd.*

(f) *The function corresponding to Graph F is*

Multiple Choice:

(i) *neither even nor odd.*
(ii) *even, but not odd.*
(iii) *odd, but not even.* ✓
(iv) *both even and odd.*

(g) *The function corresponding to Graph G is*

Multiple Choice:

(i) *neither even nor odd.*
(ii) *even, but not odd.*
(iii) *odd, but not even.*
(iv) *both even and odd.* ✓

(h) *The function corresponding to Graph H is*

Multiple Choice:

(i) *neither even nor odd.* ✓
(ii) *even, but not odd.*
(iii) *odd, but not even.*
(iv) *both even and odd.*

`FP3.tex`

Exercise 43 (a) *The function f defined by $f(x) = 12x$ is*

Multiple Choice:

(i) *even.*
(ii) *odd.* ✓
(iii) *neither even nor odd.*
(iv) *both even and odd.*

(b) *The function f defined by $f(x) = 12x + 2$ is*

Multiple Choice:

(i) *even.*
(ii) *odd.*
(iii) *neither even nor odd.* ✓
(iv) *both even and odd.*

(c) *The function f defined by $f(x) = 12$ is*

Multiple Choice:

(i) *even.* ✓
(ii) *odd.*
(iii) *neither even nor odd.*
(iv) *both even and odd.*

(d) *The function f defined by $f(x) = 5x^2 - 4$ is*

Multiple Choice:

(i) *even.* ✓
(ii) *odd.*
(iii) *neither even nor odd.*
(iv) *both even and odd.*

(e) *The function f defined by $f(x) = 3x^3 - 5x$ is*

Multiple Choice:

(i) *even.*
(ii) *odd.* ✓
(iii) *neither even nor odd.*
(iv) *both even and odd.*

(f) *The function f defined by $f(x) = 0$ is*

Multiple Choice:

(i) *even.*
(ii) *odd.*
(iii) *neither even nor odd.*
(iv) *both even and odd.* ✓

`FP4.tex`

Exercise 44 *The set of integers is the set* $\{\ldots, -3, -2, -1, 0, 1, 2, 2, \ldots\}$ *consisting of all counting numbers, their negatives, and zero.*

The floor *of* x*, denoted* $\lfloor x \rfloor$ *is defined to be the largest integer* k *with* $k \leq x$*. For example,* $\lfloor 5.2 \rfloor = 5$*,* $\lfloor -99.9 \rfloor = -100$ *and* $\lfloor -3 \rfloor = -3$*.*

(a) *The function* f *defined by* $f(x) = \lfloor x \rfloor$ *is*

Multiple Choice:

(i) *odd.*
(ii) *even.*
(iii) *neither odd nor even.* ✓
(iv) *both odd and even.*

(b) *The function* f *defined by* $f(x) = \lfloor x \rfloor$ *is*

Multiple Choice:

(i) *one-to-one.*
(ii) *not one-to-one.* ✓

`FP5.tex`

Exercise 45 *When studying trigonometry, you will learn that both* sin *and* cos *are periodic functions with period* 2π*. This means that for all inputs* x*,* $\sin(x + 2\pi) = \sin(x)$ *and* $\cos(x + 2\pi) = \cos(x)$ *.*

(a) *Consider the function* f *defined by* $f(x) = 2\sin(x)$*.* f *is*

Multiple Choice:

(i) *not periodic.*
(ii) *periodic with period* π*.*
(iii) *periodic with period* 2π*.* ✓
(iv) *periodic with period* 3π*.*
(v) *periodic with period* 4π*.*

(b) *Consider the function* g *defined by* $g(x) = \cos(x + 5)$*.* g *is*

Multiple Choice:

(i) *not periodic.*
(ii) *periodic with period* π.
(iii) *periodic with period* 2π. ✓
(iv) *periodic with period* 3π.
(v) *periodic with period* 4π.

(c) *Consider the function* h *defined by* $h(x) = \sin(x) + 2\cos(x)$. h *is*

Multiple Choice:

(i) *not periodic.*
(ii) *periodic with period* π.
(iii) *periodic with period* 2π. ✓
(iv) *periodic with period* 3π.
(v) *periodic with period* 4π.

`FP6.tex`

Exercise 46 *When studying trigonometry, you will learn that* sin *is an odd function and* cos *is an even function. This means that for all inputs* x, $\sin(-x) = -\sin(x)$ *and* $\cos(-x) = \cos(x)$. *Additionally,* sin *is not even, and* cos *is not odd.*

(a) *Consider the function* f *defined by* $f(x) = 7.2\sin(x)$. f *is*

Multiple Choice:

(i) *even.*
(ii) *odd.* ✓
(iii) *neither even nor odd.*

(b) *Consider the function* g *defined by* $g(x) = \cos(x) + 308$. g *is*

Multiple Choice:

(i) *even.* ✓
(ii) *odd.*
(iii) *neither even nor odd.*

(c) *Consider the function* h *defined by* $h(x) = \sin(x) + \cos(x)$. *For reference, here is a graph of* h *on Desmos:*

Desmos link: https://www.desmos.com/calculator/t0r1zihobf

h is

Multiple Choice:

(i) *even.*

(ii) *odd.*

(iii) *neither even nor odd.* ✓

FP7.tex

Exercise 47 *When studying trigonometry, you will learn that both* sin *and* cos *are periodic functions with period* 2π.

Many functions that can be built out of sin *and* cos *are also periodic. In this exercise, we'll use Desmos to explore how the period can change.*

(a) *Consider the function f defined by $f(x) = \sin(3x)$. For reference, here is a graph of f on Desmos:*

Desmos link: https://www.desmos.com/calculator/uc3meehtpv

The period of f is

Multiple Choice:

(i) π.

(ii) 2π.

(iii) 3π.

(iv) 6π.

(v) $\frac{\pi}{2}$.

(vi) $\frac{2\pi}{3}$. ✓

(b) *Consider the function g defined by $g(x) = \cos\left(\frac{x}{3}\right)$. For reference, here is a graph of g on Desmos:*

Desmos link: https://www.desmos.com/calculator/364oqkoauu

The period of g is

Multiple Choice:

(i) π.
(ii) 2π.
(iii) 3π.
(iv) 6π. ✓
(v) $\frac{\pi}{2}$.
(vi) $\frac{2\pi}{3}$.

(c) *Consider the function h defined by $h(x) = \sin(2x - \pi)$. For reference, here is a graph of h on Desmos:*

Desmos link: https://www.desmos.com/calculator/wha8ccbi93

The period of h is

Multiple Choice:

(i) π. ✓
(ii) 2π.
(iii) 3π.
(iv) 6π.
(v) $\frac{\pi}{2}$.
(vi) $\frac{2\pi}{3}$.

FP8.tex

Exercise 48 *In each part, an invertible function f will be defined. For each function, find its inverse.*

(a) $f(x) = 2x - 6$
$f^{-1}(x) = \boxed{\frac{6+x}{2}}$

(b) $f(x) = 29 - x$
$f^{-1}(x) = \boxed{29 - x}$

(c) $f(x) = \dfrac{x-3}{2} + 3$

$f^{-1}(x) = \boxed{2x - 3}$

(d) $f(x) = \sqrt{5x-1} + 3$

$f^{-1}(x) = \boxed{\dfrac{(x-3)^2 + 1}{5}}$

Part 6

Average Rate of Change

`ARoC1.tex`

Exercise 49 *Melinda grows a unique type of mango known for its sweetness and smoothness. Because of this, the price of a mango increases with the distance from Melinda's farm. The function M gives the price of a mango in dollars given the distance x in miles from Melinda's farm:*

$$M(x) = \frac{1}{100}x^2 + 4$$

(a) *Compute $AV_{[1,10]}$.*

$AV_{[1,10]} = \$\boxed{1.11}$ *per mile from Melinda's farm.*

(b) *Compute $AV_{[200,300]}$.*

$AV_{[200,300]} = \$\boxed{5}$ *per mile from Melinda's farm.*

`ARoC2.tex`

Exercise 50 *The temperature T in degrees Fahrenheit t hours after 6 AM is given by:*

$$-\frac{1}{2}t^2 + 8t + 32,$$

for $0 \leq t \leq 12$.

(a) $T(4) = \boxed{56}^\circ F$. *This is the temperature at*

Multiple Choice:

(i) *4AM.*
(ii) *10AM.* ✓
(iii) *4PM.*
(iv) *10PM.*

(b) *The average rate of change of T over the interval $[4, 8]$ is* $\boxed{2}$.

(c) *The average rate of change of T from $t = 8$ to $t = 12$ is* $\boxed{-2}$.

(d) *The average rate of temperature change between 10 AM and 6 PM is* $\boxed{0}$.

(e) *The units for the rates above are*

Multiple Choice:

(i) *degrees Fahrenheit.*

(ii) *degrees Celsius.*

(iii) *degrees Celsius per hour.*

(iv) *degrees Celsius per minute.*

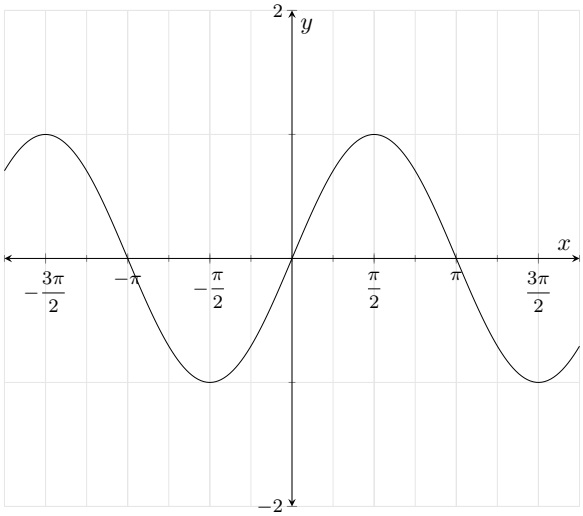
(v) *degrees Fahrenheit per hour.* ✓

(vi) *degrees Fahrenheit per minute.*

`ARoC3.tex`

Exercise 51 *Let* $f(x) = \sin(x)$. *The following information about the sine function may be helpful.*

$f(x) = \sin(x)$



Important Values of $f(x) = \sin(x)$	
x	$f(x)$
$-\pi$	0
$\frac{-\pi}{2}$	-1
0	0
$\frac{\pi}{2}$	1
π	0
$\frac{3\pi}{2}$	-1
2π	0

(a) *Compute* $AV_{\left[-\pi, \frac{3\pi}{2}\right]}$. *Give an exact answer.*

$AV_{\left[-\pi, \frac{3\pi}{2}\right]} = \boxed{-\frac{2}{5\pi}}$.

(b) *Based on your answer above, the sine function is*

Multiple Choice:

(i) *increasing on the interval* $\left[-\pi, \frac{3\pi}{2}\right]$.

(ii) *decreasing on the interval* $\left[-\pi, \frac{3\pi}{2}\right]$.

(iii) *constant on the interval* $\left[-\pi, \frac{3\pi}{2}\right]$.

(iv) *increasing on average on the interval* $\left[-\pi, \frac{3\pi}{2}\right]$.

(v) *decreasing on average on the interval* $\left[-\pi, \frac{3\pi}{2}\right]$. ✓

(vi) *constant on average on the interval* $\left[-\pi, \frac{3\pi}{2}\right]$.

(c) *Compute* $AV_{[0,2\pi]}$.

$AV_{[0,2\pi]} = \boxed{0}$.

(d) *Based on your answer above, the sine function is*

Multiple Choice:

(i) *increasing on the interval* $[0, 2\pi]$.

(ii) *decreasing on the interval* $[0, 2\pi]$.

(iii) *constant on the interval* $[0, 2\pi]$.

(iv) *increasing on average on the interval* $[0, 2\pi]$.

(v) *decreasing on average on the interval* $[0, 2\pi]$.

(vi) *constant on average on the interval* $[0, 2\pi]$. ✓

`ARoC4.tex`

Exercise 52 *The height of an object dropped from the roof of an eight story building is modeled by* $h(t) = -16t^2 + 64$, *where* $0 \leq t \leq 2$. *Here,* h *is the height of the object off the ground in feet,* t *seconds after the object is dropped.*

The slope of the line through the points $(0, h(0))$ *and* $(2, h(2))$ *is* $\boxed{-32}$.

`ARoC5.tex`

Exercise 53 *Using data from Bureau of Transportation Statistics, the average fuel economy* F *in miles per gallon for passenger cars in the US can be modeled by* $F(t) = -0.0076t^2 + 0.45t + 16$, *for* $0 \leq t \leq 28$, *where* t *is the number of years since 1980.*

(a) *Compute* $AV_{[0,28]}$.

$AV_{[0,28]} = \boxed{0.2372}$.

(b) *In this context,* $AV_{[0,28]}$ *represents*

Multiple Choice:

(i) *the average fuel economy for passenger cars in the US from 1980 to 2008.*

(ii) *the average price of fuel in the US from 1980 to 2008.*

(iii) *the average rate of change of the average fuel economy for passenger cars in the US from 1980 to 2008.* ✓

(c) *The units of* $AV_{[0,28]}$ *are*

Multiple Choice:

(i) *miles.*

(ii) *miles per gallon.*

(iii) *miles per gallon per year.* ✓

(iv) *miles per year.*

`ARoC6.tex`

Exercise 54 *Let* $f(x) = \dfrac{1}{x}$.

(a) *Compute* $AV_{[1,2]}$.

$AV_{[1,2]} = \boxed{-\dfrac{1}{2}}$.

(b) *Compute* $AV_{[100,101]}$.

$AV_{[100,101]} = \boxed{-\dfrac{1}{10100}}$.

`ARoC7.tex`

Exercise 55 *Let* $f(x) = x^3$.

(a) *Compute* $AV_{[3,5]}$.

$AV_{[3,5]} = \boxed{49}$.

Part 7

Rational Functions

`RF1.tex`

Exercise 56 *Select all expressions below which define rational functions:*

Multiple Choice:

(a) $\dfrac{x^4 - x + 1}{x^2 + 2x + 1}$ ✓

(b) $\dfrac{\sin(x^6 - 4x^3 + 7)}{x^8 - 10x^3 + 10x^2}$

(c) $\dfrac{x^{1000}}{x^{10} - x^9}$ ✓

(d) $x^7 - 34x^6 + 5x^2 + 10$ ✓

(e) $\cos\left(\dfrac{3x^5 + 4x^4 - 8x^3}{8x^9 - 45x^5 + 9x + 15}\right)$

(f) $\dfrac{4x + 5}{\sqrt{x^6 + 15}}$

`RF2.tex`

Exercise 57 *The rational function*

$$f(x) = \frac{x^6 + x^4 - 12x + 1}{x^2 - 7x + 6}$$

is defined for all real values of x, except for (in increasing order) $x =$ $\boxed{1}$ *and $x =$* $\boxed{6}$.

`RF3.tex`

Exercise 58 *Rewrite the rational function*

$$f(x) = \frac{x^2 - 4}{x - 1} + \frac{x^2 - 3x}{x - 2}$$

in the form $f(x) = p(x)/q(x)$.

Answer: $f(x) = \dfrac{\boxed{2x^3 - x - 6x^2 + 8}}{\boxed{x^2 - 3x + 2}}$.

`RF4.tex`

Exercise 59 *The rational function*

$$f(x) = \frac{x^2 - 4x + 4}{(x-2)(x^2 - 7x + 12)}$$

is defined for all real values of x, except for (in increasing order) $x = \boxed{2}$, $x = \boxed{3}$, and $x = \boxed{4}$.

`RF5.tex`

Exercise 60 *Rewrite the rational function*

$$f(x) = \frac{x^3 + 4x}{x^2 + 2} - \frac{x + 3}{x^2 - 1}$$

in the form $f(x) = p(x)/q(x)$.

Answer: $f(x) = \dfrac{\boxed{x^5 + 2x^3 - 3x^2 - 6x - 6}}{\boxed{x^4 - x^2 + 2x^2 - 2}}$.

`RF6.tex`

Exercise 61 *Find the line equation describing the horizontal asymptote, if it exists, of the rational function:*

$$f(x) = \frac{x^4 - 3x^3 + 10x + 1}{x^6 - 10x^5 + 5x^2 - 7}$$

Write "NO" if there is no such asymptote. Answer: $\boxed{y = 0}$.

`RF7.tex`

Exercise 62 *Consider the rational function*

$$f(x) = \frac{x^2 - 12x + 35}{x^2 - 8x + 15}$$

(a) *The values c_1 and c_2 for which $f(x)$ is undefined are, in increasing order, $c_1 = \boxed{3}$ and $c_2 = \boxed{5}$.*

(b) *For the value c_1, we have a*

Multiple Choice:

(i) *Hole in the graph of $y = f(x)$.*
(ii) *Vertical asymptote of line equation $y = c_1$.* ✓

(c) *For the value c_2, we have a*

Multiple Choice:

(i) *Hole in the graph of $y = f(x)$.* ✓
(ii) *Vertical asymptote of line equation $y = c_2$.*

`RF8.tex`

Exercise 63 *Find the line equation describing the horizontal asymptote, if it exists, of the rational function:*

$$f(x) = \frac{4x^5 + 100x^3 - 21x^2 + x}{3x^5 - 4x^3 + 12x^2 - 10}$$

Write "NO" if there is no such asymptote. Answer: $\boxed{y = 4/3}$.

`RF9.tex`

Exercise 64 *Consider the rational function*

$$f(x) = \frac{(x^4 + 1)^3}{(x^2 - 13x + 36)^2}$$

(a) *The values c_1 and c_2 for which $f(x)$ is undefined are, in increasing order,* $c_1 = \boxed{4}$ *and* $c_2 = \boxed{9}$.

(b) *For the value c_1, we have a*

Multiple Choice:

(i) *Hole in the graph of $y = f(x)$.*
(ii) *Vertical asymptote of line equation $y = c_1$.* ✓

(c) *For the value c_2, we have a*

Multiple Choice:

(i) *Hole in the graph of* $y = f(x)$.

(ii) *Vertical asymptote of line equation* $y = c_2$. ✓

`RF10.tex`

Exercise 65 *Find the line equation describing the horizontal asymptote, if it exists, of the rational function:*

$$f(x) = \frac{6x^8 - 5x^5 + 6x^2 + 10}{10000x^5 - 10x^3 + 8x^2 + 99}$$

Write "NO" if there is no such asymptote. Answer: $\boxed{NO}$.

`RF11.tex`

Exercise 66 *Consider the rational function*

$$f(x) = \frac{(x-1)^2(x-2)^5(x-3)^3(x-4)^2}{(x-1)^3(x-2)^4(x-3)^3(x-4)^6}.$$

Select the correct options below, regarding the graph of $y = f(x)$.

Multiple Choice:

(a) *The line* $x = 1$ *is a vertical asymptote.* ✓

(b) *There is a hole in the graph with* x*-coordinate equal to* 1.

(c) *The line* $x = 2$ *is a vertical asymptote.*

(d) *There is a hole in the graph with* x*-coordinate equal to* 2. ✓

(e) *The line* $x = 3$ *is a vertical asymptote.*

(f) *There is a hole in the graph with* x*-coordinate equal to* 3. ✓

(g) *The line* $x = 4$ *is a vertical asymptote.* ✓

(h) *There is a hole in the graph with* x*-coordinate equal to* 4.

`RF12.tex`

Exercise 67 *Perform a long division to find the correct quotient and remainder:*

$$\frac{5x^4 - 3x^3 + 2x^2 - 1}{x^2 + 4} = \boxed{5x^2 - 3x - 18} + \frac{\boxed{12x + 71}}{x^2 + 4}$$

RF13.tex

Exercise 68 *Find the line equation (in the form $y = mx + b$) describing the slant asymptote, if it exists, of the rational function*

$$f(x) = \frac{3x^6 - 6x^5 - 5x^2 + 2x - 15}{5x^4 + 6x^3 + 3x^2 - 6}.$$

Write "NO" if there is no such asymptote. Answer: $\boxed{NO}$.

RF14.tex

Exercise 69 *Perform a long division to find the correct quotient and remainder:*

$$\frac{-x^5 + 7x^3 - x}{x^3 - x^2 + 1} = \boxed{-x^2 - x + 6} + \frac{\boxed{7x^2 - 6}}{x^3 - x^2 + 1}$$

RF15.tex

Exercise 70 *Find the line equation (in the form $y = mx + b$) describing the slant asymptote, if it exists, of the rational function*

$$f(x) = \frac{x^3 - 3x + 1}{x^2 + 1}.$$

Write "NO" if there is no such asymptote. Answer: $\boxed{y = x}$.

RF16.tex

Exercise 71 *Find the line equation (in the form $y = mx + b$) describing the slant asymptote, if it exists, of the rational function*

$$f(x) = \frac{-5x^4 - 3x^3 + x^2 - 10}{x^3 - 3x^2 + 3x - 1}.$$

Write "NO" if there is no such asymptote. Answer: $\boxed{y = -5x - 18}$.